

VISION FOR ADAPTIVE MANAGEMENT



Draft Working Paper: August 28, 1997

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August 28, 1997

Dear Reviewers:

We are pleased to transmit the third installment of the Ecosystem Restoration Program Plan (ERPP), Volume III: Vision for Adaptive Management. In this volume, we provide our first effort to identify, describe, and integrate our draft visions for adaptive management, phased implementation, ecosystem monitoring, focused research, and begin the process of identifying indicators of ecological health. In doing so, we reemphasize the implementation objectives presented in Volume I: Visions for Ecosystem Elements; describe a draft process of how we propose to attain the targets by implementing the programmatic actions presented in Volume II: Ecological Zone Visions; and present a process to adaptively restore health to an ever-changing ecosystem using experimentation, pilot projects, and change in response to new information.

Please note that we have set a 45-day review period, ending on October 14, 1997, during which we hope to receive your written comments on Volumes I, II, and III. Keep in mind that Volumes I and II are draft reports while Volume III is a draft working paper. Early submittal of comments of Volumes I and II would help us begin refining those reports. Your comments on Volume III will assist in refining the adaptive management approach and the development of a draft Volume III.

The importance of adaptive management to the ERPP has become increasingly apparent in recent months as we developed Volumes I and II and as we worked to provide this draft of Volume III. We firmly believe that an effective ecosystem restoration program is one that has the support of the participating agencies, stakeholders, interested individuals, and local landowners. We view the refinement of Volume III and the development of an effective adaptive management program as the glue which will hold the ERPP together during the next 25 years and guide our ecosystem restoration plan implementation.

Therefore, we present Volume III as our very first cut at describing the adaptive management process with important sections that address implementation, monitoring, indicators, and research. We have much work to do in refining this volume, and during the refinement process we need to make certain it reflects the needs and desires of the participating agencies and our urban, agricultural, and environmental stakeholders as well as affected landowners and interested individuals. To develop a fully integrated adaptive management program that has your support, we plan to host a series of small focus group

Department of Fish and Game

Department of Water Resources

which actions need to be implemented. The tiering is an assessment of the number and types of actions identified in the ERPP that need to be implemented to restore ecological health.

The following describes the tiering of the level of actions among the five geographic regions designated within the solution scope of the ERPP.

SACRAMENTO-SAN JOAQUIN DELTA

The legally defined Delta is comprised of all four Ecological Units of the Sacramento-San Joaquin Delta Ecological Zone and the Suisun Bay and Marsh Ecological unit of the Suisun Marsh/North San Francisco Bay Ecological Zone. The approach in the legally defined Delta differs from the approach in the remainder of the Ecological Zones and Units in the two following ways:

- Extensive focus on habitat including targets and programmatic actions.
- Inclusion of targets for listed species which may have a broad distribution in the ERPP study area but are manifest in the Delta as a "problem."

SACRAMENTO AND SAN JOAQUIN RIVERS, TRIBUTARY WATERSHEDS, AND SUISUN AND NORTH SAN FRANCISCO BAYS

The CALFED approach for the Ecological Zones and Units outside the legally defined Delta is to restore important ecological processes, habitats, and species to address problems manifest in the Delta. Generally, the species list is confined to fish species, and the habitat is predominantly riparian and riverine aquatic.

UPPER WATERSHEDS

CALFED is supportive of watershed restoration programs and efforts within the upper watersheds which result in measurable benefits to the Delta. The ERPP has developed general targets and programmatic actions for the upper watersheds which are designed to promote and complement

local watershed planning and management efforts. (Note: Watershed management is also included in the CALFED Water Quality Common Program.)

CENTRAL AND SOUTH SAN FRANCISCO BAY WATERSHED

CALFED supports watershed restoration programs and efforts within the Central-South San Francisco Bay area. South Bay programs and projects in which CALFED would participate must be closely linked to alleviation of problems that are manifest in the Delta as a problem. To date, we have not identified the required linkage. The ERPP has not developed targets or programmatic actions for this area.

NEARSHORE PACIFIC OCEAN

The nearshore Pacific Ocean is included in the solution area. The ERPP has not developed targets or programmatic actions that directly address habitat conditions in the ocean. The ERPP has developed targets and programmatic actions to encourage improved harvest management and regulations.

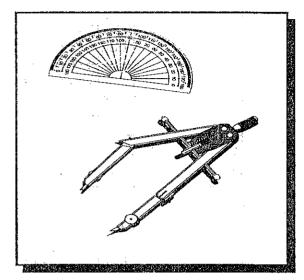
IMPLEMENTATION STRATEGY

A large and diverse ecosystem like the Bay-Delta is extremely complex. There are many processes and relationships at work in the ecosystem that are not fully understood. Thus, there are many difficulties and uncertainties associated with a program to improve ecosystem health. In some cases, problems are well understood and the steps to improvement are clear. In other cases, there is some understanding of the reasons for decline but this understanding is not sufficient to warrant full-scale implementation of remedial measures. In still other cases, additional research is needed before solutions can be identified with certainty.

The difficulties and uncertainties of ecosystem restoration call for an implementation strategy that is flexible and can accommodate and respond to new information. The foundation of the ERPP implementation strategy is adaptive management.



STRATEGIES FOR PHASED IMPLEMENTATION



INTRODUCTION

Phased implementation is subordinate to the adaptive management process and is an approach to implement actions identified in the ERPP. Phased implementation is comprised of a multistage priority strategy which assists in identifying and sequencing the implementation of the ERPP restoration actions.

At the programmatic level, this section on phased implementation provides a snapshot of potential implementation emphasis over time. A 25-year implementation period is selected to display one potential variation in emphasis grouped within five 5-year increments. The present assessment of emphasis over the life of the program is based on existing knowledge and assumptions regarding the need for certain types of actions. This level of analysis is consistent with the programmatic level treatment of the overall CALFED Bay-Delta Program's storage and conveyance alternatives and the other common programs (e.g., water quality, water use efficiency, and levee system reliability).

Phased implementation within the shorter term 5year implementation programs will be modified on a recurrent basis as a result of adaptive management and the collection and evaluation of new or improved information. The shorter-term implementation programs developed within the framework of adaptive management may vary significantly from the programmatic snapshot of implementation. This is consistent with the theme of adaptive management and reflects the feedback and evaluation loops needed to refine and adjust the implementation program in the short-term.

ASSUMPTIONS

A number of assumptions are required to develop the programmatic level phased implementation program for the 25-year period after the Environmental programmatic report/Statement is certified. (The anticipated date of certification is the fall of 1998.) These assumptions guide and assist in the development of a process for implementing the ERPP. The assumptions include: the assurances package for the ecosystem restoration, funding and financial strategy, ERPP implementation strategies, focus area and tiered emphasis for implementation. preferred alternative for storage and conveyance. integration with the other common programs and development of a habitat conservation plan (HCP).

These assumptions are not well-defined at this stage of the CALFED process but will be clarified and refined in early 1998.

FUNDING

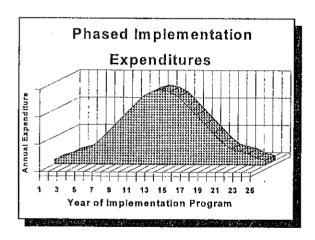
The total for implementing the ERPP has been very roughly estimated at \$1.5 billion. About half of that is available through Proposition 204 bond and expected federal appropriations. These funds will be used to provide the initial infusion of capital to move the implementation program forward. In later years, the magnitude of the annual implementation program may be constrained by the annual availability of funding. Phasing, and the overall adaptive management program, is ultimately influenced by the availability of restoration funds throughout the duration of the program, individual and cumulative



Volume III: Ecosystem Restoration Program Plan Strategies for Phased Implementation Draft Working Paper: August 28, 1997 costs to implement the ERPP, and priority strategies that select for specific actions to reach specific targets.

This ERPP assumes that the \$390 million identified in Proposition 204 will become available after the CALFED Bay-Delta Program's final EIR/EIS is formally adopted by the CALFED agencies through the filing of a Record of Decision for the federal EIS and certification of the EIR by the California Resources Agency by late Fall 1998. It is assumed that these funds will be encumbered and spent during a 25-year period which provides a pro-rated fund availability of approximately \$15 million per year. The projected expenditure of funds will likely follow a bell-shaped curve (see inset). This is necessary to develop the infrastructure needed for implementation. monitoring of indicators, focused research, and post-project evaluations.

It is also assumed that expenditures in any single year will not be limited if suitable projects exist for implementation.



Category III is assumed to complete the expenditure of \$180 million during the first five years on actions identified for early implementation.

Other sources of funding available during the early implementation phase include \$429 million which may be available through a series of federal appropriations.

It is also assumed the CVPIA will continue to be implemented and that an estimated \$20 million to \$35 million per year for 25 years (\$500 million to \$875 million estimated total) will be spent on restoration actions, most of which will be closely related or identical with actions in the ERPP.

ASSURANCES

The phased implementation process will be directed and constrained by the slate of assurances linked to ecosystem restoration (refer to earlier section on adaptive management, page 14).

IMPLEMENTATION FOCUS AREAS

The geographic scope of the ERPP is defined by the interdependence and linkage of watersheds, streams, rivers and the Bay-Delta and the complex life histories of the dependent fish, wildlife and plant communities. The restoration of ecological processes requires implementation of actions throughout much of the Central Valley, its upper watersheds, the Bay-Delta, and near-shore ocean. The primary geographic focus is the Bay-Delta, the Sacramento River, the San Joaquin River, and their tributary watersheds directly connected to the Bay-Delta system below major dams and reservoirs. Secondarily, the ERPP addresses. programmatic level, the near-shore ocean, South San Francisco Bay, lower San Joaquin Valley, and the upper watersheds above the major dams.

The primary geographic focus area for the ERPP is divided into 14 zones, each characterized by a predominant physical habitat type and species assemblage. These 14 ecological zones constitute the geographic areas in which the majority of restoration actions will occur.

TIERED EMPHASIS

The CALFED approach to the development of ecosystem restoration targets and programmatic actions in the ERPP study area varies by area. These areas receive varying levels of specificity and emphasis. (refer to tiered emphasis in introductory section of this volume).



CUMULATIVE BENEFITS

Many projects proposed by the ERPP will be implemented simultaneously. In addition, other agencies are implementing restoration programs, such as the Anadromous Fish Restoration and Anadromous Fish Screening programs authorized by the Central Valley Project Improvement Act. This may restrict the opportunity to develop evaluations of the ecological benefit from individual projects. In the long-term, this may be a minor problem, but in the short-term and early stages of the implementation program, the ability to judge the merits of single types of restoration actions is very important in providing information for adaptive management and the structuring of the longer-term program.

The ERPP assumes that monitoring programs will be developed as companion projects to provide the best possible assessment of the merits of individual projects.

IMPLEMENTATION INFRASTRUCTURE

Refinement and implementation of the programmatic actions identified in the ERPP will require an extensive agency infrastructure. Major components of this infrastructure include project development, engineering analysis and design. environmental permitting, construction. construction oversight, contract administration, and post-project evaluations. It is assumed that the early years of implementation will be constrained until the management infrastructure is fully developed.

IMPLEMENTATION STRATEGIES

The implementation strategy for the ERPP is comprised of many component parts. These include strategies for the following categories of implementation projects.

- levee setbacks and floodplain improvements
- unscreened diversions
- fish passage

- riparian and riverine aquatic habitat restoration
- contaminants
- water acquisition
- land acquisition and conversion to habitat
- control of invasive organisms (plant and animal)
- sediment supply
- temperature control
- harvest, and
- other elements.

Each component has a variable approach to phased implementation and differing ranking criteria for project consideration.

STRATEGY FOR LEVEE SETBACKS AND FLOODPLAIN IMPROVEMENTS

The strategy for setback levees and floodplain improvement projects is to closely coordinate with the CALFED Levee System Integrity Common Program. This program is directed at levees and channels in the Sacramento-San Joaquin Delta Ecological Zone. The strategy also includes close coordination with the Governor's Flood Control Task Force, the Corps of Engineers Sacramento River flood control program and others.

The strategy includes efforts to advise in setting program and project priorities for these other programs for the purpose of moving ecologically beneficial projects outlined in the ERPP to the forefront.

The strategy for levee setbacks and floodplain improvements is to coordinate ERPP restoration actions with the following:

- Levee System Integrity Common Program -closely coordinate levee system reconstruction
 projects to provide ecological benefits in the
 Delta. These benefits will be most closely
 related to developing shallow water areas with
 emergent vegetation, developing areas of
 riparian vegetation, and improving Delta
 channel hydraulics.
- U.S. Corps of Engineers Sacramento River Flood Control Project.



- Governor's Flood Emergency Action Team (FEAT) recommendations.
- Other floodplain restoration activities such as those sponsored by local counties and conservation groups.

STRATEGY FOR WATER ACQUISITION

The strategy for water acquisition is a very important part of the ERPP. Water is actively being sought through a variety of State and federal programs such as the State Water Bank and Central Valley Project Improvement Act. The ERPP strategy is closely linked to these existing programs.

- Central Valley Project Improvement Act water acquisition programs.
- Water Use Efficiency Common Program.
- State Water Bank.
- Storage component of CALFED preferred alternative.

STRATEGY FOR LAND ACQUISITION AND CONVERSION TO HABITAT

The strategy for land acquisition in the Sacramento-San Joaquin Delta and Suisun Marsh for conversion to various types of aquatic or tidally influenced habitats includes the development of conservation easements or the direct acquisition of lands from willing sellers. Lands under consideration must be suitable for conversion to at least one of the following uses:

- TIDAL PERENNIAL AQUATIC HABITAT in the Sacramento-San Joaquin Delta or Suisun Marsh/North San Francisco Bay Ecological Zones;
- NONTIDAL PERENNIAL AQUATIC HABITAT in the Sacramento-San Joaquin Delta or Suisun Marsh/North San Francisco Bay Ecological Zones;

- SALINE EMERGENT WETLANDS in the Suisun Marsh/North San Francisco Bay Ecological Zone;
- FRESH EMERGENT WETLANDS in the Sacramento-San Joaquin Delta Ecological Zone;
- SEASONAL WETLANDS in the Sacramento-San Joaquin Delta or Suisun Marsh/North San Francisco Bay Ecological Zones;
- PERENNIAL GRASSLANDS in the Sacramento-San Joaquin Delta or Suisun Marsh/North San Francisco Bay Ecological Zones; and
- AGRICULTURAL LANDS in the Sacramento-San Joaquin Delta Ecological Zone.

STRATEGY FOR UNSCREENED DIVERSIONS

The strategy for reducing the adverse impacts of unscreened diversions in the Central Valley is to closely coordinate restoration projects with the Department of Fish and Game, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service. The Department of Fish and Game has legal authority under the Fish and Game Code to install or require diverters to install positive barrier fish screens on diversions. The U.S. Fish and Wildlife Service is required under Section 3406(b)(21) of the Central Valley Project Improvement Act (CVPIA) to "assist the State of California in efforts to develop and implement measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions on the Sacramento and San Joaquin Rivers, their tributaries, the Sacramento-San Joaquin Delta, and the Suisun Marsh. Such measures shall include but shall not be limited to construction of screens on unscreened diversions. rehabilitation of existing screens, replacement of existing non-functioning screens, and relocation of diversions to less fishery-sensitive areas."

The Department of Fish and Game has statutory responsibility for unscreened diversions and has an



existing unscreened diversions program and staff. The U.S. Fish and Wildlife Service is authorized under the CVPIA to assist the State and has an Anadromous Fish Screening Program and staff. The CALFED strategy is to provide whatever assistance or support these agencies need to fully implement their respective programs as soon as possible.

STRATEGY FOR FISH PASSAGE

The strategy to improve fish passage in the ERPP Study Area is to closely coordinate potential actions with the Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Bureau of Reclamation, local watershed conservancies, landowners, and other interest groups.

A relatively small number of solvable fish passage barriers exist and the strategy includes the development of a timeline to completely eliminate or reduce the adverse impacts of these stressors.

STRATEGY FOR RIPARIAN AND RIVERINE AQUATIC HABITAT RESTORATION

Riparian and riverine aquatic habitat is a very important ecosystem element that is found in every ecological zone and most ecological units. The strategy has several component parts: development of conservation easements, acquisition of land from willing sellers, cooperative programs with local landowners, and incorporation of measures to enhance or restore riparian communities in conjunction with other restoration projects such as set back levees, and floodplain restoration programs.

The strategy also includes close coordination with the Upper Sacramento River Fisheries and Riparian Habitat Advisory Council which seeks to restore riparian habitat along the Sacramento River between Red Bluff Diversion Dam and Colusa, and the San Joaquin River Riparian Restoration Program for actions along the San Joaquin River between Friant and the confluence with the Merced River

It also includes close coordination with the U.S. Fish and Wildlife Service which is directed by Section 3406(b)(1)(A) of the CVPIA to protect and restore natural channel and riparian habitat values.

STRATEGY FOR CONTAMINANTS

The strategy for contaminants includes close coordination with the CALFED Water Quality Common Program. This program has developed strategies for mine drainage, urban and industrial runoff, municipal and industrial wastewater, agricultural drainage, and other parameters of concern in the Sacramento Basin, San Joaquin Basin, and Sacramento-San Joaquin Delta.

The ERPP strategy is to assist this program in those water quality areas that would provide substantial improvements in the health of aquatic resources, particularly for listed species and anadromous fish.

STRATEGY FOR CONTROL OF INVASIVE ORGANISMS

The strategy for the control of invasive aquatic plants, invasive aquatic organisms, invasive riparian and salt marsh plants, and non-native wildlife is to fully cooperate and coordinate with research control and programs. existing Cooperating agencies include the U.S. Department of Agriculture, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, California Department of Water Resources, California Department of Fish and Game, State Water Resources Control Board, California Department of Food and Agriculture, California Department of Health Services, and numerous nonprofit organizations, societies, land trusts, and private landowners.

The strategy is to participate in the priority setting processes and to support control programs and control measures that will contribute to the



CALFED objective of improving the ecological health of the Bay-Delta system.

STRATEGY FOR SEDIMENT SUPPLY

The strategy for restoring or enhancing natural sediment supplies to Central Valley rivers and streams and the Delta is to develop cooperative programs with the aggregate resource industry for the purpose of relocating gravel extraction activities to areas away from active stream channels.

The strategy also includes assessment of areas where natural sediment supply cannot be restored and developing collaborative programs to artificially supplement sediment and gravel supplies.

The strategy to improve natural sediment supplies along the major rivers such as the Sacramento River is closely linked to maintaining or restoring the meander zone and allowing natural erosion of streambanks to provide a continual supply of sediment to the system.

This strategy includes close coordination with the U.S. Fish and Wildlife Service which is required by Section 3406(b)(13) of the CVPIA to develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the upper Sacramento River from Keswick Dam to Red Bluff Diversion Dam and in the American and Stanislaus Rivers downstream of Nimbus and Goodwin Dams, respectively.

STRATEGY FOR STREAM TEMPERATURES

The strategy for improving stream temperatures is through four elements: structural temperature control devices on large reservoirs, water management operations to conserve the cool water pools, long-term protection and restoration of riparian and riverine aquatic habitats, and control of agricultural and other warm water discharges.

STRATEGY FOR HARVEST

The strategy for harvest has several elements: develop better management data, develop a better tool to evaluate population and harvest impacts in the long-term, and increase wildlife enforcement efforts directed at reducing illegal harvest. These data include review of hatchery goals and production constraints, release strategies, implementation of a comprehensive coded-wire tagging program, and completion of genetic studies to clarify genetic status of hatchery stocks.

The indices of ocean exploitation and population size of Central Valley chinook have been developed based on ocean troll and recreational harvests south of Point Arena and estimates of Central Valley chinook spawning escapements. This index is called the Central Valley Index (CVI) and has been calculated since 1970, when escapement estimates for all races of Central Valley chinook were first available. The CVI is sensitive to changes in the magnitude of the inland sport harvest relative to spawning escapement. Recent basinwide angler surveys have estimated inland recreational catch at levels approaching 25% of the fish entering the basin.

Presently, the PFMC finds that comparison of either the actual CVI abundance or the ocean harvest index is not a satisfactory tool to evaluate population or harvest impact trends in the long-term.

PRIORITY PROTOCOLS

The purpose of the ERPP is to implement remedial measures to improve ecological processes, habitats, and species which ultimately contribute to the CALFED long-term goal of restoring ecological health and improving water management for beneficial uses of the Bay-Delta system. Each ecosystem element has a discrete implementation objective that is fixed through time. Each ecosystem element has one or more targets and



enough to require the creation of new priority setting protocols.

The first pass at setting priorities needs to be programmatic in nature and consider the 25-year implementation phase of the program. Stressors that are known sources of mortality to fish, wildlife, and plant resources could have a high priority early in the program that lessen in future years as the problems are abated. Likewise, projects that will take a decade or more to implement, such as land acquisition and conversion to habitat, may benefit from having a high priority early in the program.

Regardless, the programmatic priority scheme needs to be multidimensional by considering the 25-year implementation period, projected availability of funding, needs of endangered species, assurances, and reflecting the preferred alternative for storage and conveyance.

BASIS FOR SETTING 5-YEAR IMPLEMENTATION PRIORITIES

The CALFED mission and ecosystem quality goal and objectives provide a basis for developing initial criteria to rank restoration projects by priority. The mission, ecosystem quality goal, and objectives follow:

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

The CALFED ecosystem quality goal is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.

The CALFED ecosystem quality objectives are to (A) improve and increase aquatic habitats so that they can support the sustainable production and survival of native and other desirable estuarine and anadromous fish in the estuary, (B) improve and

increase important wetland habitats so that they can support the sustainable production and survival of wildlife species, and (3) increase population health and population size of Delta species to levels that assure sustained survival.

The following ranking criteria (three levels) reflect application the CALFED mission, ecosystem quality goal, and ecosystem quality objectives and are designed to allow categorization at the programmatic level of the more than 600 programmatic actions presented in ERPP Volume II: Ecological Zone Visions. This is an example of how ranking criteria could be developed based on species status and their influence on beneficial uses of water in the Delta. It is presented for discussion purposes. (Appendix 2, page 89, presents additional information regarding the relationship of priority species to ecological processes, habitats, and stressors.)

FIRST LEVEL RANKING CRITERIA

Species which have produced a conflict between species status and water management in the Bay-Delta are placed in the first level rank.

Companion criteria:

Habitats which support species that have produced a conflict between species status and water management in the Bay-Delta.

Processes which create and maintain habitats which support species that have produced a conflict between species status and water management in the Bay-Delta.

Stressors which impair ecological processes and habitats needed to support species or which cause direct or indirect mortality to species that have produced a conflict between species status and water management in the Bay-Delta.

First level species:

- winter-run chinook salmon
- delta smelt



striped bass.

Rationale: The CALFED process is a result of the need to resolve conflicts in the Bay-Delta between the health of several species of fish and other beneficial uses of water in the Delta, above the Delta, and in export service areas. For example, ESA biological opinions for winter-run chinook and delta smelt influence or control water project operations at Shasta Dam, Red Bluff Diversion Dam, Chico Landing, Delta Cross Channel, and export timing and quantity at the Delta pumping plants. The status of winter-run chinook salmon has also resulted in additional constraints on ocean sport and commercial harvest of chinook salmon. Because of this conflict, these species require a high level of effort to reduce the conflicts between the species, their status, and other uses for water. (Note: There is a strong basis to include steelhead, spring-run chinook salmon, and splittail as first level species and to demote striped bass to a lower level. Public and agency comments will assist in sorting the species into the appropriate category.)

SECOND LEVEL RANKING CRITERIA

Species which will likely produce additional conflict between fisheries and water management in the Bay-Delta if their status does not improve are placed in the second level rank.

Companion criteria:

Habitats which support species which will likely produce additional conflict between fisheries and land use and water management in the Bay-Delta if their status does not improve.

Processes which create and maintain habitats which support species which will likely produce additional conflict between fisheries and land use and water management in the Bay-Delta if their status does not improve.

Stressors which impair ecological processes and habitats needed to support species or which cause direct or indirect mortality to species which will likely produce additional conflict between fisheries and land use and water management in the Bay-Delta if their status does not improve.

Second level species:

- steelhead trout
- spring-run chinook salmon
- late-fall-run chinook salmon
- fall-run chinook
- splittail
- longfin smelt
- green sturgeon

Rationale: The species included in the second level ranking criteria are presently being considered for additional protection under the ESA. Because of their potential to increase or lengthen the conflict between species status and beneficial uses of water in the system, species also require high efforts to reduce the conflicts and improve their status and condition of habitats upon which they depend. Many of the ecological processes, habitats, and stressors identified for first level species are also manifest in the status of the second level species. In many instances, actions directed at first level species will also contribute to improving conditions for second level species. However, the distribution and habitat requirements of some second level species differs significantly from first level species.

THIRD LEVEL RANKING CRITERIA

Species which contribute to overall ecosystem health and provide resilience to fisheries and water management in the Bay-Delta are placed in the third rank.

Companion criteria:

Habitats which support species which contribute to overall ecosystem health and provide resilience to fisheries and water management in the Bay-Delta.

Processes which create and maintain habitats for species which contribute to overall ecosystem



health and provide resilience to fisheries and water management in the Bay-Delta.

Stressors which impair ecological processes and habitats needed to support species or which cause direct or indirect mortality to species which contribute to overall ecosystem health and provide reliance to fisheries and water management in the Bay-Delta.

Third level species:

- all other aquatic species.
- all terrestrial species
- all plant species.

Rationale: The health of the Bay-Delta watershed is dependent on its component parts. These

components include the ecological zone, ecological units, and ecosystem elements (ecological processes, habitats, and species). The basis for the program is to resolve the conflicts between species status and water management. Yet, resolution of these conflicts will not completely provide for the ecological health of the Delta and its watershed, nor would it provide for the level of resilience needed to ensure long-term sustainability of health. Elements in the third level remain very valuable components needed to contribute to long-term system stability.

APPENDIX 3. PHASED IMPLEMENTATION

ECOSYSTEM RESTORATION PROGRAM EMPHASIS DURING THE 25-YEAR IMPLEMENTATION PERIOD

The following section presents the programmatic level of effort for each ERPP ecosystem element. These elements are described in *Volume I: Visions for Ecosystem Elements*, and programmatic actions for the elements are presented in *Volume II: Ecological Zone Visions*. The level of effort is a relative assessment of the anticipated funding for implementation, focused research, and monitoring and overall importance of the programmatic actions for each ecosystem element.

The information is displayed for the 25-year duration of the implementation program. The next important level of priority setting will occur in the development of the 5-year implementation programs and will be adjusted based on adaptive management and information gathered by focused research and monitoring. The 5-year and longer-term implementation program could be modified as a result of provisions to be contained in the HCP.

Key

Level of Code Effort

High

Medium

Low

The level of effort is presented in graphical form (see key inset).

PROGRAMMATIC ACTIONS RELATED TO CENTRAL VALLEY STREAMFLOW AND WATER ACQUISITION

Water acquisition for environmental purposes is coequal in importance to land acquisition and conversion to habitat for restoring ecological health to the Bay-Delta system. Water acquisition will be a high priority for the first 15 years of the program and will be influenced by the selection of the preferred alternative for the EIR/S. Provisions for the development of storage facilities upstream of the Delta will influence the acquisition program for environmental water needs. Regardless, water acquisition will remain a high priority for much of the implementation period.

Ecosystem Element	Implementation Interval (Years)						
Ecological Process	1-5	6-10	11-15	16-20	20-25		
Streamflow/Water Acquisition							

PROGRAMMATIC ACTIONS RELATED TO IMPROVING SEDIMENT SUPPLIES

Sediment supply is an important ecosystem component that is linked to a variety of ecological processes and habitats. Sediment supplies are impaired by stream bank protection, gravel mining, and levee construction. These same stressors also impair riparian and riverine aquatic habitats. Because of its importance to health of the Bay-Delta ecosystem, efforts to protect and restore sediment supplies are given a high priority for the



first 15 years of the program. Focused research and monitoring during the early years of the implementation program will provide a basis to refine the restoration approach.

Ecosystem Element Implementation Interval (Yes				al (Years)	
Ecological Process	1-5	6-10	11-15	16-20	20-25
Improve Sediment Supply					

PROGRAMMATIC ACTIONS RELATED TO RESTORING STREAM MEANDER CORRIDORS

Restoration of stream meander corridors is an important element of the restoration program and is particularly valuable in restoring ecological health of the Sacramento River. Restoration of the meander corridor is closely linked to restoring riparian and riverine aquatic habitat, improving natural sediment supplies, and in maintaining suitable annual streamflow patterns and water volumes to allow the stream to erode their stream banks and meander within portions of their historic floodplains. Removal of stressors such as bank protection (riprap), levees, bridge abutments, and other actions can contribute to improved opportunities for meander. Due to the anticipated complexity and legal issues related to restoring meander, a moderate level of effort is anticipated during the first 10 years of the program. The program may then have a high level of effort if legal issues are resolved and if focused research and monitoring of small scale projects indicate the approach is successful and will contribute to the long-term ecological health of the Bay-Delta system.

Ecosystem Element		al (Years)			
Ecological Process	1-5	6-10	11-15	16-20	20-25
Stream Meander Corridor					

PROGRAMMATIC ACTIONS RELATED TO IMPROVING FLOODPLAINS AND FLOOD PROCESSES

Levee setback projects need to be implemented on a small scale in the initial 5-years of the program. Then, based on the results of monitoring and focused research, a longer-term plan can be refined and implemented. If the initial efforts provide the anticipated improvements in ecological health and benefits to species, the intensity of the program should be high for the next 10-year period.

Ecosystem Element		Impleme	ntation Interv	al (Years)	
Ecological Process	1-5	6-10	11-15	16-20	20-25
Levee Setbacks					



PROGRAMMATIC ACTIONS RELATED TO IMPROVING STREAM TEMPERATURES

Stream temperatures below the major impoundments in the ERPP study area often impair the migration, spawning, incubation, and survival of anadromous fish. Where possible, structural and operational remedies should be identified and implemented. Evaluations and actions to remedy elevated water temperatures is rated as requiring a high level of effort during the first 10 years of the program, followed by 10 years of moderate effort, then by low effort. The basis for this recommended level of effort is that structural and operational remedies can be developed an implemented in the first 10 years. Opportunities for improvement during the next 10 years will be limited, and if the program is successful, very few opportunities or need for temperature control will be present in the later stages of the implementation program. Focused research and monitoring during the early years of the program will provide the information needed to guide subsequent efforts.

Ecosystem Element		Implemen	itation Interva	ol (Years)	
Ecological Process	1-5	6-10	11-15	16-20	20-25
Improve Stream Temperatures					

PROGRAMMATIC ACTIONS RELATED TO IMPROVING BAY-DELTA HYDRAULICS

Improving flow directions and channel hydraulics in the Delta is very dependent on the selection of a preferred alternative for storage and conveyance. The first five years of the program will receive a low level of effort while engineering and modeling studies are completed to determine the best approach to improving Delta hydraulics. It is anticipated that the next five years would be used to evaluate small scale efforts to improve hydraulic conditions and the larger scale implementation program would be implemented after the conveyance alternative is more fully developed and perhaps partially implemented.

Ecosystem Element		Impleme	ntation Interv	al (Years)	
Ecological Process	1-5	6-10	11-15	16-20	20-25
Bay-Delta Hydraulics					

PROGRAMMATIC ACTIONS RELATED TO IMPROVING THE BAY-DELTA AQUATIC FOODWEB

Prior to implementing measures to improve the health of the Bay-Delta aquatic foodweb, additional focused research is needed in several areas. The health of the foodweb may be influenced by invasive aquatic organisms, export of water from the Delta, input of organic carbon and other nutrients from the San Joaquin and Sacramento River systems, Delta channel hydraulics, and the areal extent of mudflats and other shallow water areas. Focused research and monitoring of the aforementioned elements is required prior to making decisions regarding specific actions to attempt to improve the aquatic foodweb. The opportunity or need to implement actions may also be influenced by the selection of the preferred alternative for storage and conveyance.



Ecosystem Element		Impleme	ntation Interv	al (Years)	
Ecological Process	1-5	6-10	11-15	16-20	20-25
Bay-Delta Aquatic Foodweb					

PROGRAMMATIC ACTIONS RELATED TO IMPROVING UPPER WATERSHED PROCESSES

Restoring and maintaining upper watershed processes is an important element that must be included in the long-term restoration program and is needed to ensure system resiliency and support for anadromous fish, particularly steelhead trout and spring-run chinook salmon. Watershed planning and restoration are important to the ERPP but will have a stronger tie to the Water Quality Common Program. It is anticipated that a low level of effort will be directed to watershed planning during the first 5 years of the ERPP implementation program. Likely, planning and restoration efforts will increase in subsequent years.

Ecosystem Element		Impleme	ntation Interv	al (Years)	1
Ecological Process	1-5	6-10	11-15	16-20	20-25
Upper Watershed Processes					

PROGRAMMATIC ACTIONS RELATED TO RESTORATION OF RIPARIAN AND RIVERINE AQUATIC HABITATS

Restoration of riparian vegetation has a high priority during the early years of the implementation program. This program is linked to the acquisition of land from willing sellers through fee or easement and conversion to habitat. Based on the first and second level species lists, significant effort to restore this type of habitat is required on the Sacramento River between Red Bluff Diversion Dam and Colusa, along the mainstem San Joaquin River below the mouth of the Merced River in the Delta, and along streams that support spring-run chinook salmon and steelhead.

After the first 5-year effort, the program will be reevaluated based on the results of monitoring and focused research to redesign the implementation program for the subsequent intervals. The present recommendation is to implement an aggressive program after the results of the first 5 years are assessed, and scaled back to a moderate acquisition/restoration program late in the implementation program.

Ecosystem Element		Impleme	ntation Interv	al (Years)	
Habitat	1-5	6-10	11-15	16-20	20-25
Riparian Restoration					



PROGRAMMATIC ACTIONS RELATED TO CONVERTING LAND TO HABITAT FOR AQUATIC SPECIES

This is a cumulative view of acquiring and converting land for tidal perennial habitat, Delta sloughs, midchannel islands and shoals, and saline emergent wetlands. These are types of habitat required to restore anadromous and estuarine fish species and to contribute to the health of the Bay-Delta aquatic foodweb.

Land acquisition and conversion to habitat is a significant element in the overall restoration program. The level of effort during the first five years should be moderate. Land is expensive and the timeline for completing acquisitions or easements can be lengthy. In addition, after land is acquired, habitat development plans must be developed and then implemented. The environmental benefits of conversion of land to habitat cannot be assessed on a small scale and the adaptive management element should include fairly large efforts to increase habitat along with the implementation of suitable monitoring to assess the potential benefits of the effort.

The recommended approach is to implement high level of land acquisition and conversion programs for the last 20 years. Based on the results of monitoring and focused research, implement an intensive conversion program for the next ten years. This implementation element could be modified by provisions or requirements in the HCP.

Ecosystem Element	Implementation Interval (Years)				9-4
Habitat for Aquatic Species	1-5	6-10	11-15	16-20	20-25
Convert Land to Habitat					

PROGRAMMATIC ACTIONS RELATED TO CONVERTING LAND TO HABITAT FOR TERRESTRIAL SPECIES

This is a cumulative view of acquiring and converting land for nontidal perennial aquatic habitat, fresh emergent wetlands, seasonal wetlands, inland dune scrub, perennial grasslands, and agricultural lands. These are types of habitat required to restore terrestrial, vernal pool, and plant species and communities.

Land acquisition and conversion to habitat for terrestrial species is an important element in the overall restoration program. The level of effort during the first five years should be moderate. Land is expensive and the timeline for completing acquisitions or easements can be lengthy. In addition, after land is acquired, habitat development plans must be developed and then implemented. The environmental benefits of conversion of land to habitat cannot be assessed on a small scale and the adaptive management element should include fairly large efforts to increase habitat along with the implementation of suitable monitoring to assess the potential benefits of the effort.

The recommended approach is to implement land conversion programs at a low level for the first 5 years and then, based on the results of monitoring and focused research, implement a moderate level conversion program for the next 15 years. This implementation element could be modified by provisions or requirements in the HCP.



Ecosystem Element	Ecosystem Element			al (Years)	
Habitat for Terrestrial Species	1-5	6-10	11-15	16-20	20-25
Convert Land to Habitat					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF DIVERSIONS

Unscreened diversions are a source of mortality to juvenile fish species. Technology is available to install positive barrier fish screens or other new devices to prevent or reduce the entrainment of young fish. The ERPP recommends an aggressive screening program for at least the first ten years of the implementation program. During this period, monitoring and focused research will provide an assessment of how well the system is responding to the screening of diversions. This adaptive management loop will provide guidance for the later phases of the program.

Ecosystem Element	Implementation Interval (Years)				
Stressor	1-5	6-10	11-15	16-20	20-25
Unscreened Diversions					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF DAMS, RESERVOIRS, WEIRS, AND OTHER HUMAN-MADE STRUCTURES

Inadequate fish passage is a known stressor to anadromous fish populations, particularly steelhead trout and chinook salmon. The number of sites where passage is a problem is limited, and past investigations have shown that either removing the passage problem (i.e., dam) or construction of a state-of-the-art fish ladder will immediately solve the problem. The program recommendation is to invest heavily in the early years of the program to eliminate passage problems so that immediate contributions to improving ecological health and species abundance can begin to accrue.

Ecosystem Element	Implementation Interval (Years)					
Stressor	1-5	6-10	11-15	16-20	20-25	
Fish Passage						

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF LEVEES, BRIDGES, AND BANK PROTECTION

Restoration of ecological health of the Bay-Delta system has a strong link to alleviating the adverse influences of levees and bank protection programs. This element is closely linked to stream meander corridors, floodplain and flood processes, natural sediment supplies, and riparian and riverine aquatic habitats. This element is most directed at removing bank protection and setting back levees to provide for



the aforementioned ecological processes and habitats. It is anticipated that a moderate level of effort will be required during the first five years, and then, based on focused research and the results of closely aligned programs, the level of effort could be at a high level in subsequent years.

Ecosystem Element	Implementation Interval (Years)				
Stressor	1-5	6-10	11-15	16-20	20-25
Levees, Bridges, Bank Protect					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF DREDGING AND SEDIMENT DISPOSAL

Dredging and sediment disposal are necessary actions within the Bay-Delta system that cause adverse affects in the aquatic environment. Dredging is controlled and subject to protective measures designed for endangered species. In the long-term program, efforts to acquire and convert land to aquatic and terrestrial habitats will likely depend on dredged sediments as a source to provide bottom material needed to fill deep areas for conversion to shallow water habitat and provide a base for emergent vegetation. Likely, this program will have a low level of effort in the first 5 years, and moderate to high levels of effort as lands are acquired for conversion to habitat.

Ecosystem Element	Implementation Interval (Years)				
Stressor	1-5	6-10	11-15	16-20	20-25
Dredging and Sediment Disposal					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF GRAVEL MINING

Gravel mining is an important industry in the Central Valley that causes adverse affects to stream channel configuration, stream channel meander, natural sediment supply, and other ecological processes, habitats, and aquatic species. Recent studies have identified offsite sources of aggregate material that could be mined in order to protect the ecologically valuable instream gravel and sediment supplies. This is an important element that should be implemented at a high level of effort during the first 10 years of the restoration program.

Ecosystem Element	Implementation Interval (Years)					
Stressor	1-5	6-10	11-15	16-20	20-25	
Gravel mining						



PROGRAMMATIC ACTIONS RELATED TO CONTROLLING THE ADVERSE EFFECTS OF INVASIVE SPECIES

This is a programmatic view of invasive aquatic plants, organisms, and riparian and saltmarsh plants. Invasive aquatic and plant organisms and invasive riparian and saltmarsh plants are problems throughout the ERPP study area. Two areas of effort are planned: control or reduce the frequency with which new species are introduced into the system, and develop coordinated control programs for species that can be reduced. These stressors are important such that a moderate control program is envisioned during the full 25-year implementation program.

Ecosystem Element	nt Implementation Interval	al (Years)			
Stressor	1-5	6-10	11-15	16-20	20-25
Control Invasive Organisms					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF NON-NATIVE WILDLIFE

Non-native wildlife may prey on important species and reduce their abundance. In the long-term restoration program, effort may be required to control populations of predator species. This will be done after evaluations of benefits of improving habitats for the species of concern. Future actions will be developed from information gained through focused research and monitoring. It is anticipated that this element will require a low level of effort during much of the implementation period.

Ecosystem Element Stressors	Implementation Interval (Years)					
	1-5	6-10	11-15	16-20	20-25	
Non-Native Wildlife						

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF CONTAMINANTS

The actions to reduce or eliminate the adverse influences of contaminants in the Bay-Delta system is closely linked to the Water Quality Common Program. The ERPP is in a supportive role for these types of actions and can provide funding for focused research and monitoring. Due to the Water Quality Common Program's responsibility in this area, the ERPP is recommending a moderate program for contaminant reductions during the entire 25-year implementation period of its effort.



Ecosystem Element Stressor	Implementation Interval (Years)				
	1-5	6-10	11-15	16-20	20-25
Contaminant reduction					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF HARVEST

Harvest management of Central Valley chinook salmon runs can affect the number of spawners that return each season to spawn in the rivers and streams or to return to the hatcheries for artificial propagation programs. Improved harvest management strategies and regulations must be based on scientific information regarding abundance, distribution, and age at harvest or sexual maturity. Much of this effort in divided among focused research and monitoring. The focused research will emphasize coded-wire tagging programs, calibrations of ocean harvest rates, stock recruitment relationships, and genetic identity of individual stocks. This is anticipated to be an ongoing program for the entire duration of the implementation period and will likely require a moderate level of effort.

Ecosystem Element	Implementation Interval (Years)				
Stressor	1-5	6-10	11-15	16-20	20-25
Improve Harvest Management					

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF ARTIFICIAL FISH PROPAGATION

Artificial propagation programs for fish species such as chinook salmon, steelhead, and striped bass are important elements in maintaining sport and commercial fisheries. These programs also may have adverse affects on naturally produced fish. Much of the effort in this category will be directed at focused research and monitoring to assess potential operational changes to protect wild fish.

Ecosystem Element Stressor	Implementation Interval (Years)					
	1-5	6-10	11-15	16-20	20-25	
Improve Hatchery Operations						

PROGRAMMATIC ACTIONS RELATED TO REDUCING THE ADVERSE EFFECTS OF DISTURBANCE

This element will have a low level of effort throughout the duration of the 25-year implementation program. Focused research elements will likely investigate structural opportunities to prevent wind and boat wake erosion and the need for buffer zones to protect special status wildlife species.



Ecosystem Element Stressor		Impleme	ntation Interv	al (Years)	
	1-5	6-10	11-15	16-20	20-25
Disturbance			<u> </u>		
		<u> </u>			